



**FACULTY OF ENGINEERING AND ENVIRONMENT  
DEPARTMENT OF METALLURGICAL ENGINEERING  
FUELS, ENERGY AND THE ENVIRONMENT**

**EMR 2205**

**Final Examination Paper**

**August 2021**

This examination paper consists of 3 printed pages

**Time Allowed: 3 hours**

**Total Marks: 100**

**Examiner's Name: Mr N Dube**

**INSTRUCTIONS**

1. Answer **ALL QUESTIONS** in Section A and **ANY TWO** in Section B
2. Each question carries 20 marks
3. Use of calculators is permissible

**Additional Requirements: NONE**

**MARK ALLOCATION**

<b>QUESTION A1 TO B3</b>	<b>20 Marks EACH</b>
<b>PART QUESTIONS</b>	<b>As shown in each part question</b>
<b>Total Attainable</b>	<b>100</b>

**SECTION A: ANSWER ALL QUESTIONS**

**QUESTION A1**

- a) Define the following terms used in metallurgy.
- i. Fuel [2]
  - ii. Energy [2]
- b) There are a number of energy sources used in the metallurgical processing plants. Differentiate between renewable and non-renewable energy sources, giving two examples of each. [4]
- c) Name two natural sources of solid fuels and give two advantages of using them. [4]
- d) State and explain **four** effects of burning fossil fuels on the environment. [8]

**QUESTION A2**

- a) Define the term calorific value with reference to coal. [2]
- b) Table 1 shows the composition of a sulphur free bituminous coal.

*Table 1 : Composition of bituminous coal*

	Bituminous coal (wt %)
Carbon	78
Hydrogen	5
Oxygen	4.5
Nitrogen	1.2
Ash	7
Moisture	4.3

Using the data given in Table 1 and Dulong's equation, calculate:

- i. Gross calorific value on dry basis [4]
- ii. Gross calorific value on dry ash free basis [5]
- iii. Net calorific value on dry basis [4]
- iv. Net calorific value on dry ash free basis [5]

**QUESTION A3**

- a) Describe the natural cyanide attenuation process. [5]
- b) List and explain any **two** methods of cyanide destruction. [4]
- c) Describe the impact of oil and gas production on the environment. [4]
- d) Give the advantages of biological methods for the removal and recovery of heavy metals in a wastewater treatment plant. [2]
- e) State and explain the **three** stages of the air pollution cycle. [5]

**SECTION B: ANSWER ANY TWO QUESTIONS**

**QUESTION B1**

- a) Explain the importance of EIA when a project is to be established in an area. [5]
- b) State and explain the **five** steps involved in a typical metallurgical plant waste management strategy. [15]

**QUESTION B2**

Processing of minerals and production of metals has increased greatly in recent years. As a result, the quantities of waste material and pollutants have also increased. Identify and describe in detail **five** various sources of pollution from metallurgical plants and outline the measures that are taken to reduce the pollution. [20]

**QUESTION B3**

- a) Explain the role of biological processes in the treatment of effluents in the mining and metallurgical plants. On your discussion, include bioprecipitation, bioreduction, and biosorption. [10]
- b) Solid waste materials obtained from smelting ferrochrome are metal, slag, and dust. Explain the toxicity of chromium wastes and the methods used to treat or remove the chromium from soils, water and air. [10]

\*\*\*\*\*END OF QUESTION PAPER\*\*\*\*\*